International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

Recognizing & Rectifying the failure of constraint of Railway Locomotive

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Abstract- *In Railway wagon moreover as in traveler cars the braking system plays a really vital role to prevent the train, to take care of the speed of the train at intervals specific limit. Brakes are the devices on the trains to bring it to standstill. A moving train contains energy, called mechanical energy, that has to be aloof from the train so as to cause it to prevent. the best method of doing this is often to convert the mechanical energy into heat by applying brakes. The wheels prevent and eventually the train stops. This paper presents a discussion regarding the various braking systems employed in railway vehicles. This paper conjointly considers electrodynamics and magnetic force braking of trains, that is of explicit importance in high-speed trains.*

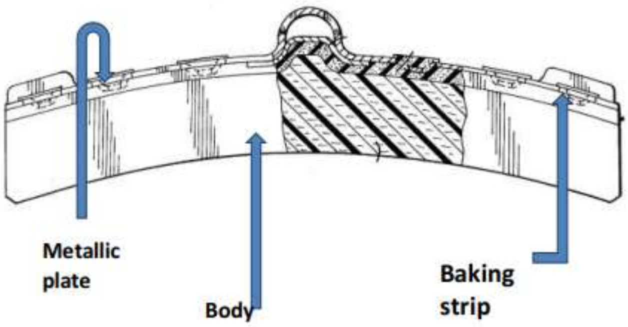
Key Words: **Mechanical energy, Electrodynamics, Braking of trains**

1. INTRODUCTION

Train braking may be a terribly complicated method, specific to rail vehicles and of nice importance by the essential contribution on the security of the traffic. This complexness results from the very fact that in braking occur varied phenomena of various sorts - mechanical, thermal, pneumatic, electrical, etc. The actions of those processes surface in varied points of the vehicles and act on totally different elements of the train, with varied intensities. the main drawback is that each one should favourably act for the meant scope, to supply economical, correct and safe braking actions. the aim of braking action is to perform controlled reduction in speed of the train, either to succeed in a definite lower speed or to prevent to a set purpose. generally terms, this happens by changing the mechanical energy of the train and therefore the potential one - just in case of circulation on slopes - into mechanical work of braking forces that sometimes turns into heat, that dissipates into the setting. At first, the rather low locomotives power and traction force allowed braking mistreatment quite straightforward handbrakes that equipped locomotives and eventually different vehicles of the train. because the development of rail transport and in line with increasing traffic speeds, tonnages and length of trains, it had been found that braking should be centralized, operated from one location - sometimes the locomotive driver's cabin and commands have to be compelled to be properly transmitted on the complete length of the train. As a consequence, on the time, for railway vehicles are developed varied brake systems, whose construction, style and operation rely on several factors like running speed, axle load, type, construction and technical characteristics of vehicles, traffic conditions, etc. Among varied principles and constructive solutions that were developed, following the studies and particularly the results of various tests, the indirect compressed gas brake tried to possess the foremost necessary benefits. Therefore, it had been generalized and remains even these days the essential and mandatory system for rail vehicles. it's still to note that, concerning the classical systems used for railway vehicles, there are many major challenges that will have an effect on the braking capability. These aspects should be all right celebrated and understood, therefore on notice applicable solutions in such a way that the issues to be overcome by applying totally different constructive, functional, operational and different kinds of measures. For example, one amongst these problems is that the basic braking systems dependency on the adhesion between wheel and rail, which may cause wheel obstruction throughout braking. This determines not solely the lengthen of the stopping distance, however conjointly the event of flat places on the rolling surface of wheels, generating robust shocks transmitted each to the means and to the vehicle, with harm to traffic safety and luxury of passengers or product transported integrity. This has generated explicit considerations concerning the look and implementation of a lot of economical wheel slip interference devices capable to avoid the above-named phenomena with as tiny as attainable reduction of braking capability. Another major drawback is that the friction between wheel and brake shoes, constraint and disc severally, that ends up in severe thermal regimes and special thermal fatigue nature efforts, requiring specific constructive and in operation standards. over that, thanks to the air softness and to the length of trains, the gas commands propagates with restricted speed within the brake pipe and, as a result, there continuously may be a delay within the braking of neighboring vehicles. As a consequence, the rear vehicles square measure running into the front ones, manufacturing giant dynamic longitudinal reactions in buffers and couplers. The elicited compression and tensile forces will reach vital levels, touching each the wheeled vehicle and therefore the track, even conducting to deteriorations of safety operation of the trains. Railway high speed operations conjointly determined a lot of severe necessities for braking systems, given to the need to develop higher braking forces and to dissipate larger amounts of energy in a very short time, to not mention the matter of damage within the case friction brakes. therein case, complementary systems whose performance and responsibly square measure safety relevant were developed to reinforce the braking capability. These many problems, even in brief given, reveal not solely the importance and complexness of braking systems used for rail vehicles, however conjointly the need of information and understanding the issues so as to develop equipments increasingly, progressively, more and more economical and reliable. a number of these aspects square measure given during this chapter.

- **2. Components of composite brake shoe**

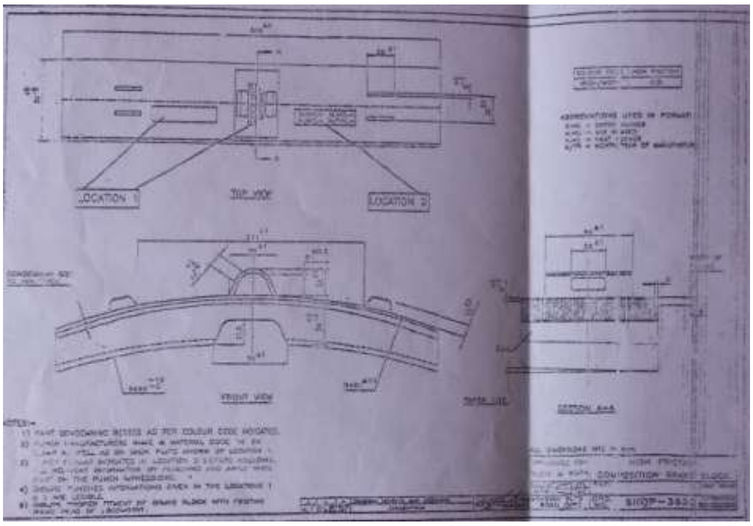
  Here the main body



- Metallic plate is mostly made of steel material having small thickness compare to other two component.
- Body which is main contact part of shoe block which is made of rubber and thermosetting phenolic resin which attached to baking strip.
- Baking strip is interposed between the back plate and body comprise made of a rubber
- Binder having dispersed there in a high strength and temperature resistance aramid fiber
- Baking strip between them for compensation of thermal expansion in metal plate and molded friction composition Metals in brake shoes
- Mostly iron oxide and some portion of exotic high temperature metals and also ceramic.
- Silicon carbide to add hardness and heat transfer.
- In baking strip binder, binder has been a rubber/resin mixture with fillers and fiber such as asbestos, glass fiber yarns.
- Baking strip made of aramid fiber have high tensile strength and temperature resistance of 400000psi and 420-5000F respectively.
- So these makes back strip more possible to function as reinforcing material when exposed to the high temperature encountered in braking.

Existing material CAST IRON brake shoe analysis

Design of brake shoe



3. STRESS ANALYSIS

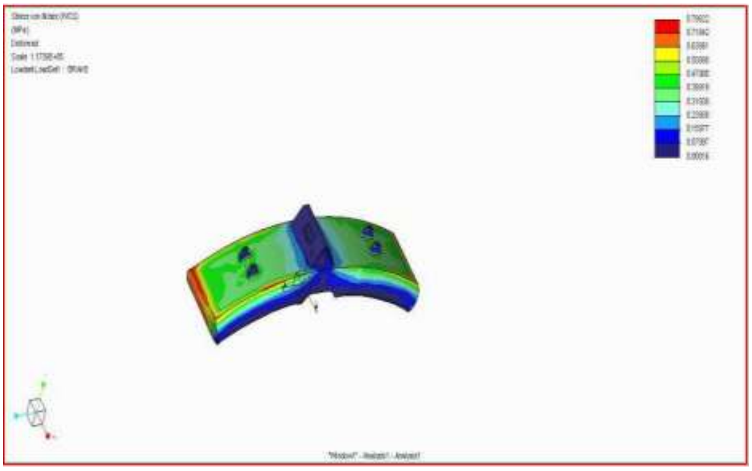
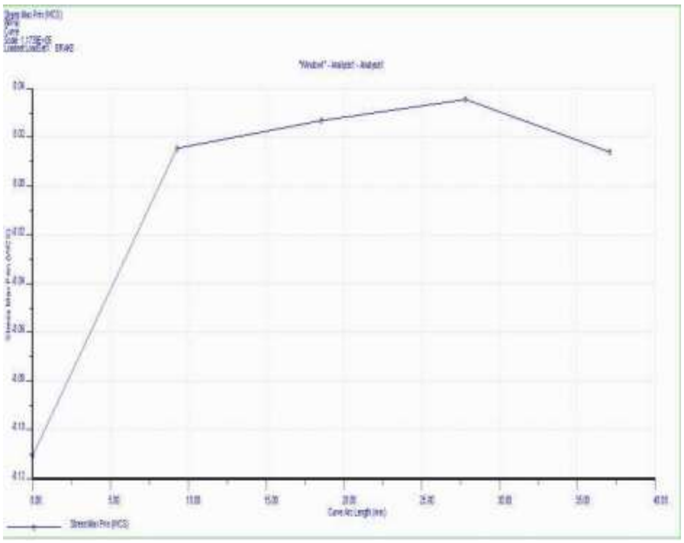


Chart -1: Stress Analysis of shoe brake

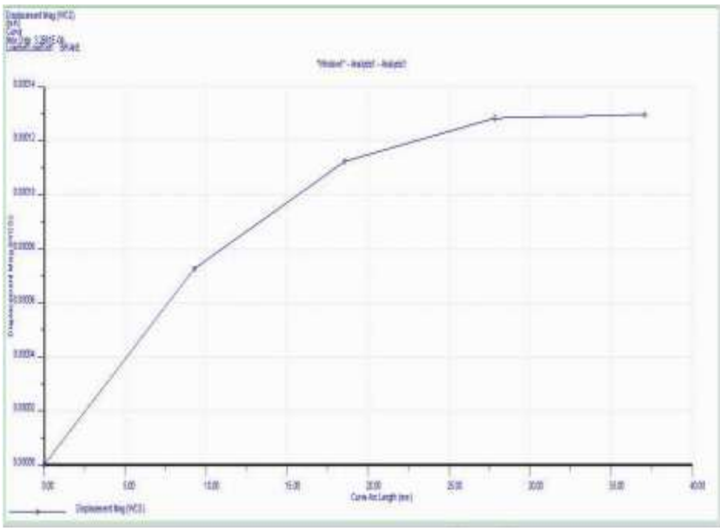
Here the red portion shows the highest portion of stress, from the creo 2.0 simulation this data is gathered. Highest stress is 0.79822 having scale of 1.1739E+05 Which value is high on the upper and lower part of the brake shoe as per analysis.

So for the stress versus distance on the upper shoe graph analysis is also shows this same situation. so when from top to bottom on shoe the stress is reduced considerably as per color chart shown above.

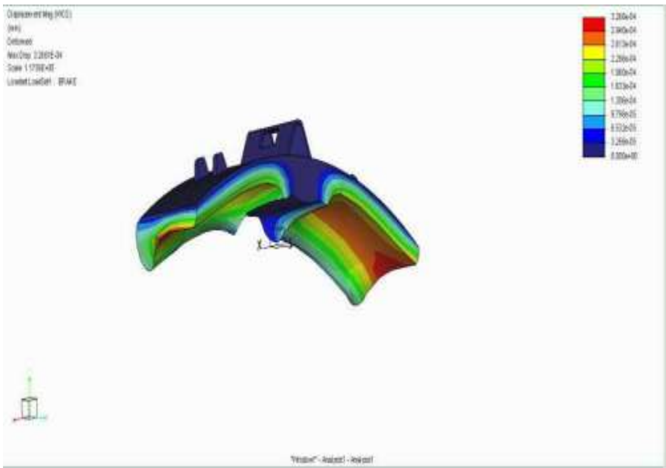
STRESS GRAPH



DISPLACEMENT GRAPH

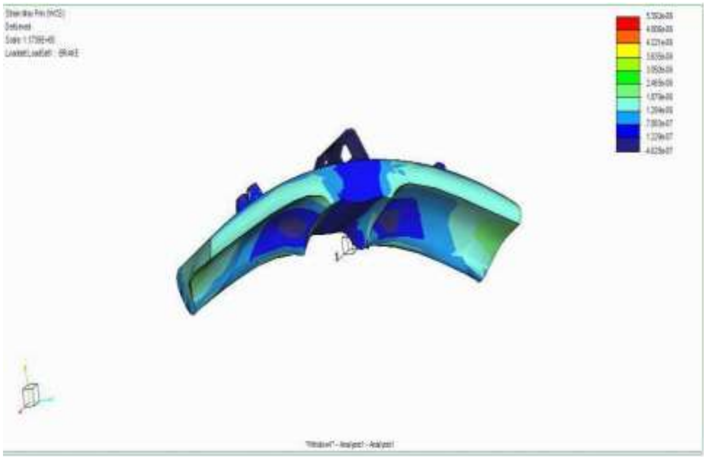


4. DISPLACEMENT ANALYSIS



Here the maximum displacement is acting at bottom of the shoe from top and bottom side as per above analysis and also for displacement verses the arc curve of the top shoe part as per above stress analysis which is of 40mm length as per scale on analysis. Here maximum displacement is 3.2616E-04

5. STRAIN ANALYSIS



Till that these are STRESS analysis maximum stress sustain is 750KPa and for the temperature analysis heat load is require and maximum temperature which can sustain the brake block is 700K.Through which Temperature stress, strain and displacement analysis are generated.

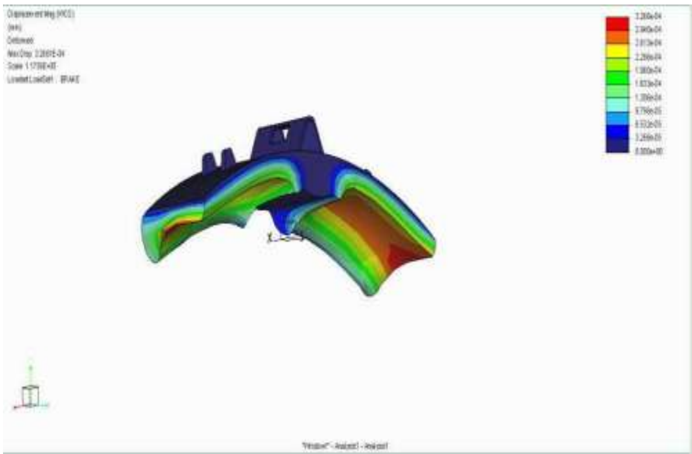
6. Temperature Analysis

Mainly temperature analysis contains.

(1) Temperature Stress

(2) Temperature Displacement

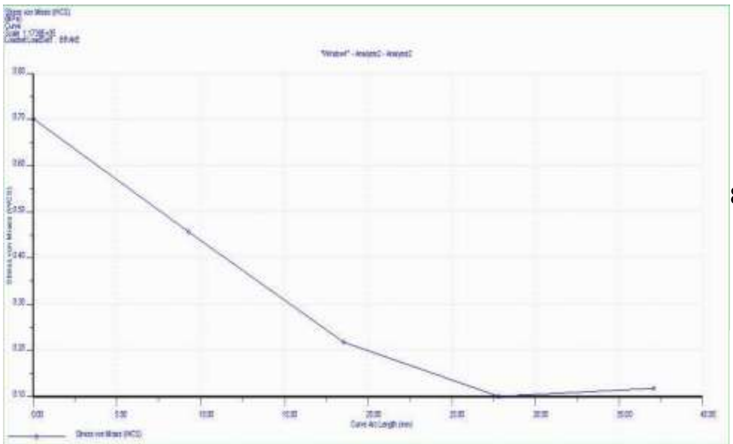
Temperature Stress analysis



Maximum temperature stress acting from analysis is 0.79822 in M Pa having a scale of 1.1739E+05.

Stresses area in mostly rubbing surface with wheel is top and bottom part of the shoe which also get deformation there. Here the area of highest pressure is less but magnitude is marginally high. Also the graph shows the complete idea of temperature range of the top surface of brake shoe.

Graph of Temperature Stress



6. Changes required in Following aspects

From everywhere the on top of analysis we tend to live that restraint failure reason will simply fly in eyes. From totally different perspective and think about of research like stress and temperature we tend to show that material is failing if it have sustain warm temperature load therefore it get additional faces displacement.

Also in high stress and displacement worth as a result of high of 750KPa, material is attempting to fail Ultimately the upkeep amount of dotty is reduced therefore dotty cannot serve longer. The set maintenance amount time for dotty is thirty days it got to come back earlier. So it simply not solely dynamic price of shoe however conjointly the out of the service of dotty is count that is very impact on RAILWAY revenue.

So if we alter the sole attainable parameter material (other parameter impact the entire railway dotty design) this expenditure will be reduced.

7. Effective Use Of composites

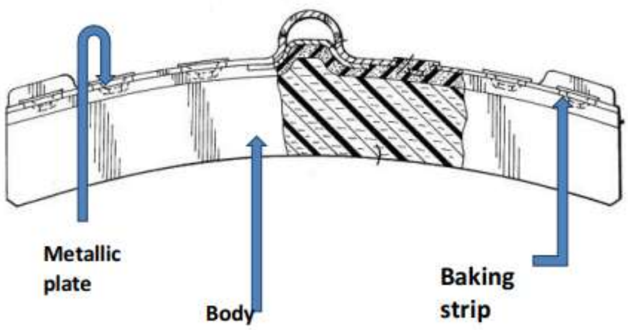
The composition of the material constituting the brake blocks must be selected so as to

Guarantee the best compromise between: -

- Friction properties.
- Wear and service life of composite blocks
- Wear on running surface of the wheels and aggressiveness against the wheel tread.
- The effect on adhesion values between the rail and wheel. And as possible co efficient of friction should be independent of applied brake pressure, temperature and braking speed
- During tests on the friction test bench on the brake blocks, there must be no flame formation, excessive smoke, bonding agent sweating, sustained crushing, severe odour formation, large area crumbling or detachment or other defects which reduces the mechanical strength.
- The backs of the brake blocks and method of connection between the backing plate and friction material must be designed so that any stresses occurring can be safely resisted.
- Heat transfer from brake shoe may be easy with backing strip used in composite material

8. Components of composite brake shoe

Here the main body



- Metallic plate is mostly made of steel material having small thickness compare to other two component. Body which is main contact part of shoe block which is made of rubber and thermosetting phenolic resin which attached to baking strip. Baking strip is interposed between the back plate and body comprise made of a rubber. Binder having dispersed there in a high strength and temperature resistance aramid fiber

Baking strip between them for compensation of thermal expansion in metal plate and moulded friction composition Metals in brake shoes Mostly iron oxide and some portion of exotic high temperature metals and also ceramic. Silicon carbide to add hardness and heat transfer. In baking strip binder, binder has been a rubber/resin mixture with fillers and fiber such as asbestos, glass fiber yarns. Baking strip made of aramid fiber have high tensile strength and temperature resistance of 400000psi and 420-5000F respectively. So these makes back strip more possible to function as reinforcing material when exposed to the high temperature encountered in braking.

Analysis of composite brake block

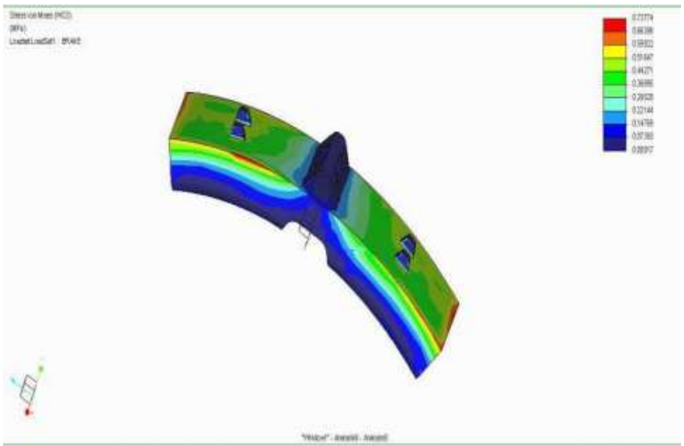
Density of the material is 2500 kg/m3

and young modulus 90 M Pa

Tensile yield stress – 200 M Pa

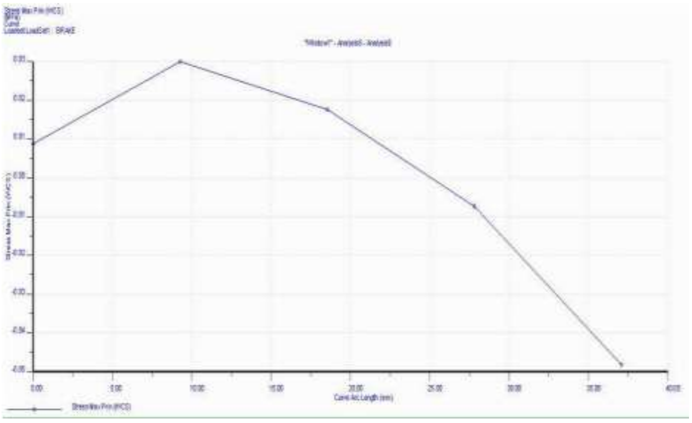
Tensile ultimate stress-250 M Pa

9. STRESS ANALYSIS

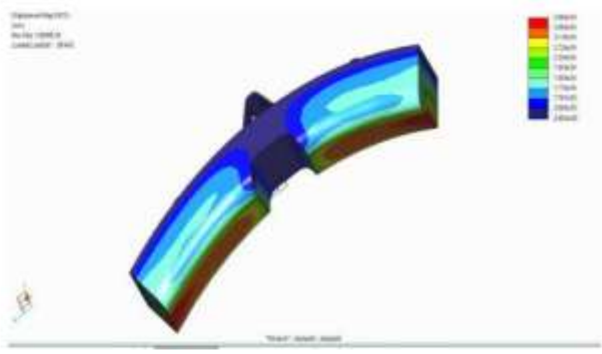


Here the range of maximum stress is 0.73774 having maximum as above stress value, which is compare to less value.

Here the range of maximum stress is also reduced from the analysis. Further the graph of stress is shown below gives complete idea of comparison.

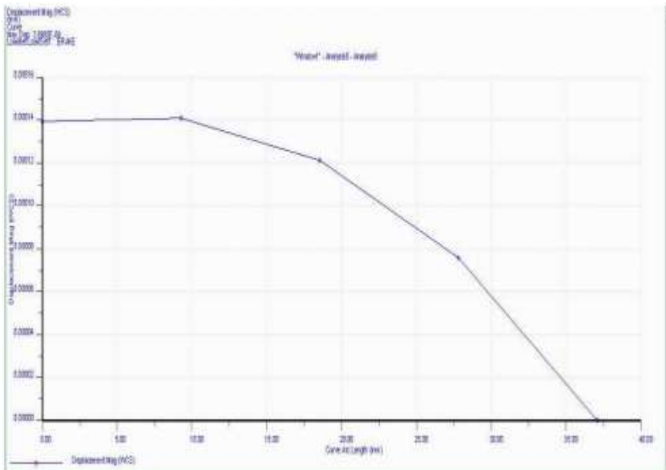


10. Displacement analysis

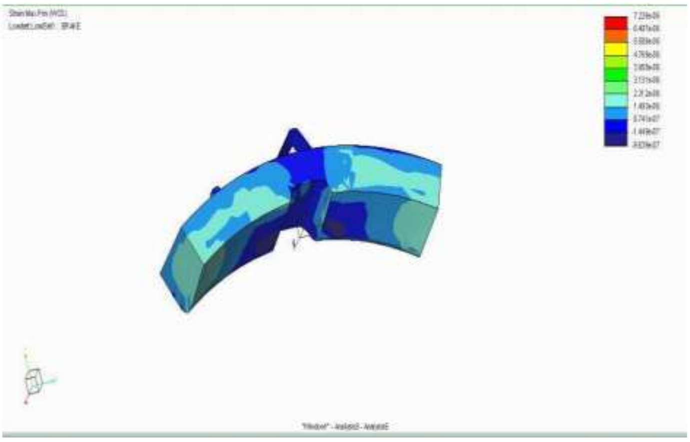


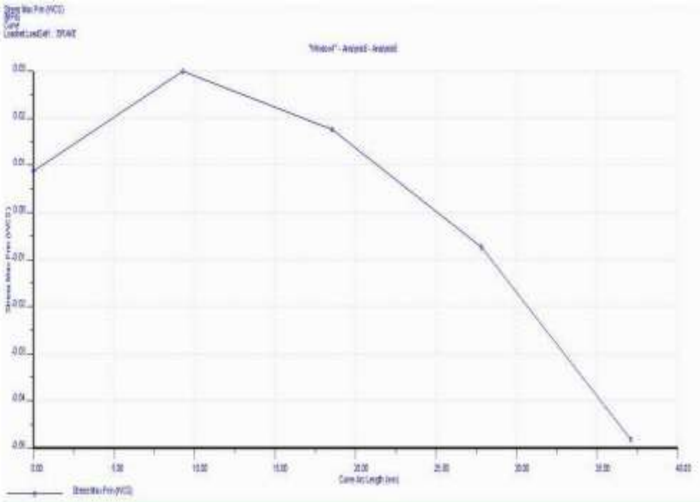
Here the maximum displacement is little bit higher but the area under the displacement curve. Also the graph shows the complete overview of the displacement analysis.

Displacement graph



11. Strain analysis



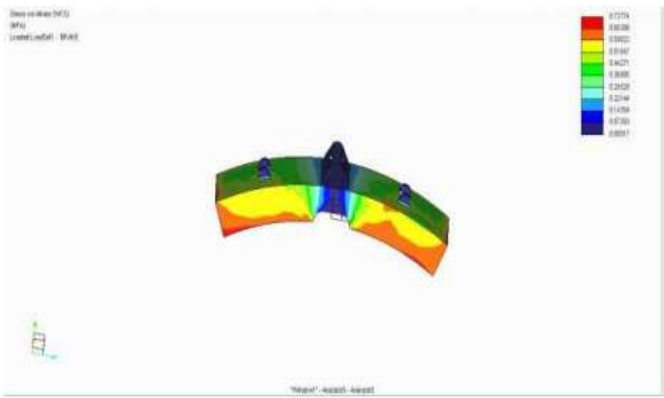


12. Temperature analysis

(1) Temperature Stress

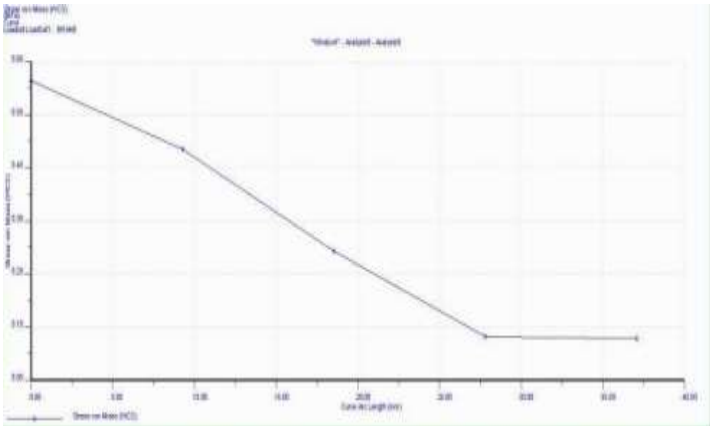
(2) Temperature Displacement

Temperature Stress analysis

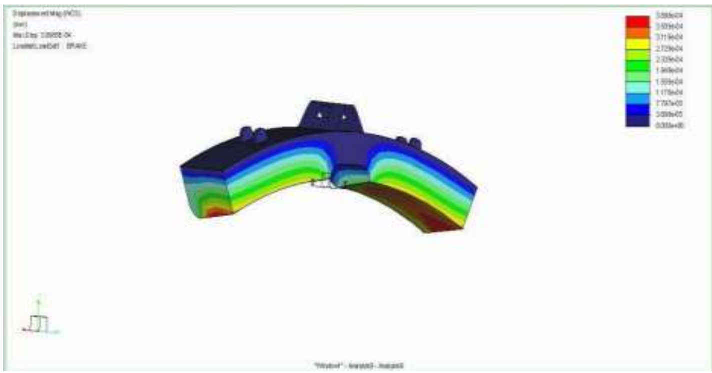


Here the temperature analysis area under the curve shoe is more compare to cast iron, but the maximum value is 0.73774 compare to 0.79 for that And temperature stress graph shown below the complete overview of the analysis.

Graph of Temperature stress:



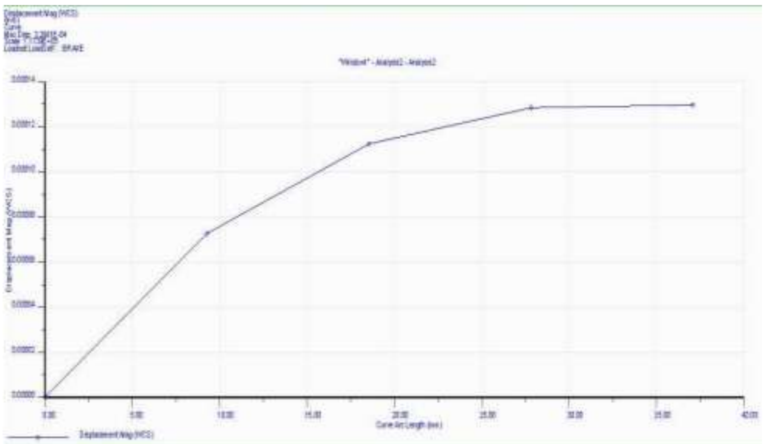
Temperature Displacement Analysis



The highest value is little bit higher than the cast iron analysis but the main perspective of shoe analysis is the stress analysis which is already reduced.

Also the graph of the temperature stress shows the idea of analysis.

Graph of Temperature displacement:



13. CONCLUSIONS

The most common failures of the brake disc embody surface cracks, that grow radially in consequent braking across the disc surface. This successively results in unilateral or bilateral cracking by the merger of the individual micro-cracks. at this time it's tough to provide one reason for these cracks. they're chiefly the consequence of variable compressive stress and tension occurring throughout braking. Resistance of the disc material for this kind of stress and therefore the sort of braking will weigh down their growth, which is able to be connected with the prolonged use of the brake discs. Rotor Disc of hydraulic brakes by victimisation new materials to enhance braking potency and supply larger stability to vehicle. an effort has been created to analyze the acceptable hybrid stuff that is lighter than forged iron and has sensible Young's modulus, Yield strength and density properties. Al base metal matrix composite and High Strength glass fibre composites have a promising friction and wear behavior as a hydraulic brake rotor. The transient thermoelastic analysis of Disc brakes in recurrent brake applications has been performed and therefore the results were compared. Finally terminated that the acceptable material for the braking operation is S2 glass fibre and every one the values obtained from the analysis square measure but their allowable values and brake Disc style is safe supported the strength and rigidity criteria.

14. Comparison table of composite material-

	Cast Iron	Composites
Stress	**0.79822**	**0.73774**
Strain	**3.26e^{-4}**	**3.898e^{-4}**
Displacement	**5.392e^{-6}**	**6.407e^{-6}**
Temperature Stress	**0.79822**	**0.79614**
Temperature Displacement	**3.266e^{-4}**	**3.898e^{-4}**

Table 1 : comparison of parameters of Cast Iron and Composites

ACKNOWLEDGEMENT

The written words have an unfortunate tendency to regenerate genuine into stilled formality. However this is the only way we have to record permanently our feelings. It gives us immense pleasure in this INPLANT TRAINING. I would like to thank MR.S.N. SHENOY (Principle AWM(c) parel, BTC) and MR. R.K.GUPTA (chief instructor BTC) for giving us this opportunity to work in the organisation. Again thankful for the facilities and privilege they provide me. I am highly obliged to all Instructors of BTC for his valuable help and guidance throughout the period. Finally I would like to all the SSE supervisor and all the workers for their valuable time they have spend for me during our training period.

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